

12 **EUROPEAN PATENT APPLICATION**

21 Application number: 82102910.5

51 Int. Cl.³: **E 05 B 47/00**
E 05 B 65/36

22 Date of filing: 05.04.82

30 Priority: 15.04.81 JP 56529/81

43 Date of publication of application:
17.11.82 Bulletin 82/46

84 Designated Contracting States:
DE FR GB

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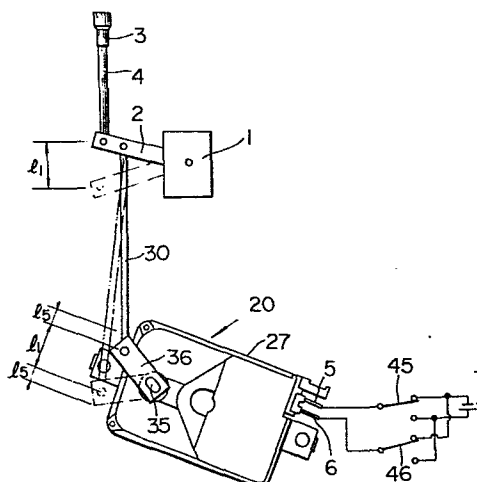
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54 Automatic door locking/unlocking device for an automotive vehicle.

57 A door lock/unlock system for an automotive vehicle has a safety means for preventing a driving unit for electrically driving a door lock mechanism between a door lock position and an unlock position from being damaged by mis-operation. The safety means inhibits power supply to the driving unit when the door locking operation is made while the door lock mechanism is in the lock position and when the door unlocking operation is made while the door lock mechanism is in unlock position.

FIG.1



**AUTOMATIC DOOR LOCKING/UNLOCKING DEVICE
FOR AN AUTOMOTIVE VEHICLE**

BACKGROUND OF THE INVENTION

5 The present invention relates generally to an
automatic door locking/unlocking device for an automotive
vehicle for locking and unlocking the vehicle door,
automatically. More particularly, the invention relates to
the automatic door locking/unlocking device which does not
10 require extremely high accuracy in manufacturing each
consisting element and in assembling them to form the door
lock mechanism.

 The automatic door locking/unlocking device
generally includes an electric reversible motor for driving
15 an actuation member to lock and unlock the vehicle door. A
door lock/unlock switch can be facilitated adjacent a
driver's seat for manual operation by a driver or a
passenger in the front seat. The electric motor is
responsive to turning on of the door lock/unlock switch to
20 lock or unlock the door depending upon the switch position.
The automatic door lock/unlock device, in turn, permits
manual door lock or unlock operation in a per se well known
manner.

 It will be appreciated that the door lock/unlock
25 switch is not always required for the automatic door
locking/unlocking device of the present invention. Namely,
the manually operable door lock mechanism of a door beside

the driver's seat can be utilized as a driving switch for driving the electric motor, in full automatic door lock/unlock system.

In such an automatic door lock/unlock device, a stop mechanism is provided for stopping the electric motor at predetermined locking and unlocking position to prevent the electric motor from overrunning. In the conventional device, the stop mechanism is adapted to detect a predetermined stroke of the actuation member movement. Therefore, unless the actuation member movement stroke accurately corresponds to the door locking position and unlocking position, the conventional door locking/unlocking device may not work well. If the stop mechanism does not work accurately, it may cause damaging of the electric motor.

To obtain an accurate stroke of the actuation member, it is required to manufacture with high accuracy the size and construction of consisting elements in the conventional device. Furthermore, assembling of the conventional automatic door locking/unlocking device also requires rather high accuracy. These requirements necessarily inhibit production of the automatic door locking/unlocking device and cause a relatively high cost thereof.

SUMMARY OF THE INVENTION

Therefore, it is an object of the present invention to provide an automatic door lock/unlock device

for an automotive vehicle which includes a means for preventing the driving unit from driving the door lock mechanism between the locking position and the unlocking position so as to cause damage to the driving unit by inhibiting the driving unit to actuate in the door locking direction while the door locking mechanism is in the locking position and in the door unlocking direction while the door locking mechanism is in the unlocking position.

Another object of the present invention is to provide a switch system for a driving circuit for automatic door lock/unlock system for an automotive vehicle, which switch system inhibits power supply to drive the door lock mechanism in a locking or unlocking direction while the door lock mechanism is already in the desired position of the door lock mechanism.

To accomplish the above-mentioned and other objects of the present invention, the door lock/unlock system according to the present invention is provided with a switch movable with an actuation member for operating the door lock mechanism between a locking direction and an unlocking direction. The movable switch is associated with the door lock and door unlock switches for disabling one of the door lock and unlock switches depending on the position thereof. The movable switch is held at the positions respectively corresponding to the door lock position and door unlock position together with the actuation member and held at the moved position even after the actuation member

...returns to its initial position.

Thereby, the driving unit of the door lock/unlock mechanism of the automotive vehicle is effectively prevented from damage caused by excessively driving the driving unit.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be understood more fully from the description given herebelow and from the accompanying drawings of the preferred embodiment of the present invention, which, however, should not be taken as limitative to the invention but for elucidation and explanation only.

In the drawings:

Fig. 1 is a front elevation of the preferred embodiment of a door lock/unlock system according to the present invention;

Fig. 2 is an enlarged front elevation of an actuator in the door lock/unlock system of Fig. 1, wherein a top plate of the actuator housing is removed to show the internal construction of the actuator;

Fig. 3 is a cross-section of the actuator of Fig. 2 taken along line III-III of Fig. 2;

Fig. 4 is a exploded perspective view of an interengagement mechanism in the actuator of Fig. 2;

Fig. 5 is a further enlarged section of a switch means in the actuator of Fig. 2;

Fig. 6 is a perspective view of the switch means

of Fig. 5 in which the switch means is illustrated with a rack member of the actuator;

Fig. 7 is a circuit diagram of a driving circuit for the actuator, which illustrates a switch position corresponding to the unlocking position of the door lock mechanism;

Fig. 8 is a circuit diagram similar to Fig. 7 to show the switch position intermediate between the locking position and unlocking position;

Fig. 9 is a circuit diagram similar to Fig. 7 showing the switch position corresponding to locking position of the door lock mechanism.

Fig. 10 is a front elevation similar to Fig. 2 showing the locking position of the actuator.

Figs. 11 to 13 are fragmentary illustration showing function of the interengagement mechanism of Fig. 4.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, particularly to Fig. 1, there is illustrated the preferred embodiment of an automatic door lock/unlock device according to the present invention. The automatic door lock/unlock device generally comprises a door lock mechanism 1 in a per se well known construction, a manually operable door lock knob 3 connected to an actuation rod 2 of the door lock mechanism 2 via a stem 4, an electrically driven actuator 20 having a driving shaft 35 and rotatable arm 36

secured to the driving shaft at one end thereof for rotation therewith. The rotatable arm 36 is connected to the actuation rod 2 of the door lock mechanism 2 via a link 30 in order to operate the door lock mechanism between a door lock position and unlock position. In Fig. 1, the position of the door lock mechanism 2 is illustrated as unlocked position in the solid line and the locked position in the phantom line. Assuming the stroke of the actuation rod 2 for changing the door lock mechanism position between the lock position and unlock position is L_1 , the rotational stroke $L_1 + 2L_5$ of the rotatable arm 36 is provided, as shown in Fig. 1, in order to effect the door lock or unlock operation by the movement of the rotatable arm 36.

The actuator 20 has electric terminals 5 and 6 extending from an actuator housing 27 and respectively connected to a vehicle battery 7 via a door lock switch 45 and a door unlock switch 46. The rotatable arm 36 with the driving shaft 35 is thus rotated in both locking and unlocking directions depending on the switch positions of the door lock switch 45 and the door unlock switch 46.

As shown in Figs. 2 and 3, the driving shaft 35 is connected to a drive pinion 37 of an electrically driven reversible motor 7 via a reduction gear assembly 40 and a rack member 8. The reduction gear assembly 38 includes an idler gear 40 and an idler pinion 39 rotatably mounted on a common axle 51. The idler gear 40 has a larger diameter than the idler pinion 39 and is associated with the latter

with an interengagement mechanism 50. As shown in Fig. 4, the interengagement mechanism 50 comprises a spring 41 inserted in a recess 51 formed on one surface of the idler gear 40. The spring 41 has generally circular configuration and having ends 52 and 53 extending from the major section of the spring. The ends 52 and 53 are normally urged in a direction away from each other. The idler gear 40 has a projection 43 protruding into the recess. The projection 43 is located in the recess so that it may abut against one the ends 52 and 53 of the spring 41. On the other hand, the idler pinion 39 is formed with a projection 42 projecting toward the recess 51 of the idler gear 40. The projection 42 is adapted to abut against one of the ends 52 and 53 while the idler pinion is rotated.

This interengagement mechanism construction permits the idler pinion 39 to rotate independently of the idler gear 40. As the idler pinion 39 is operated to rotate by the door lock knob 3 via the rack member 8, the door lock knob 3 can be manually operated independently of the motor 7 to reduce required manual operation force.

A stop switch 21 is provided for detecting the end of the rotational movement of the rack member 8 and for stopping the drive of the motor 7. The stop switch 21 generally comprises a movable contactor holder 22 with a pin 25 protruding therefrom and engageable with a cut-out 24 formed in the rack member 8 and a terminal

block 23 which is received in a recess 52 and 29 respectively formed in the housing 27 and a switch casing 28. The switch casing 28 is formed with a pair of projections 44 to resiliently hold the terminal block 23 in the recess 29.

As shown in Figs. 5 and 6, the movable contactor holder 22 is attached with a contactor 33. The contactor 33 has four terminals 33a, 33b, 33c and 33d respectively bent away from the contactor holder 22. The pin 25 of the contactor holder 22 extends through an elongated opening 53 formed in the switch casing 28 so that the contactor holder 22 can move along the elongated opening 53. Stationary terminals 32a, 32b and 32c are secured on the inner surface of the terminal block 23. The contactor holder 22 with the contactor 33 is received in a recess 26 of the terminal block 23 to mate the terminals 33a, 33b, 33c and 33d thereof to the stationary terminals 32a, 32b and 32c. The terminals 33a, 33b, 33c and 33d of the contactor 33 and the stationary terminals 32a, 32b and 32c are so related that the contactor 33 always bridges two of the three stationary terminals by contacting at least two of the four terminals to each of two stationary terminals.

The terminal block 23 is movable with respect to the recess 29 of the switch casing. The terminal block 23 is formed with teeth 31a on the outer periphery thereof. On the other hand, the switch casing 28 is formed with a

teeth 31b engageable with the teeth 31a of the terminal block 23. The teeth 31a and 31b constitute a positioning means for positioning the terminal block 23 in the recess 29.

5 Figs. 7 to 9 illustrate a driving circuit of the motor 8 in locking and unlocking positions. The stationary terminal 32a is connected to the vehicle battery 9 via the door unlock switch 46. On the other hand, the stationary terminal 32c is connected to the vehicle battery 9 via the
10 motor 7 and the door lock switch 45. The stationary terminal 32b is connected to the stationary terminals 32a, 32c via lines 34c and 34d with diodes 34a and 34b. The diodes 34a and 34b serve as safety means for preventing the motor 7 from being driven in the door locking direction
15 while the door lock mechanism is in locking position or in door unlocking direction while the door locking mechanism is in unlocking position.

The door lock switch 45 has a switching member 45a and terminals 45b and 45c. The terminal 45b is
20 connected to the positive terminal 9a of the vehicle battery via a line 45d and the terminal 45c is connected to the negative terminal 9b of the vehicle battery 9 via a line 45e. Likewise, the door unlock switch 46 has a switching terminal 46a and terminals 46b and 46c. The
25 terminal 46b is connected to the positive terminal 9a of the vehicle battery 9 via lines 46d and 45d, and the terminal 46c is connected to the negative terminal of the

.. vehicle battery 9 via lines 46e and 45e. The switching members 45a and 46a are normally urged to the terminals 45c and 46c to be connected to the negative terminal 9b of the vehicle battery.

5 In the position of the actuator 20 of Fig. 2, the door lock mechanism 1 is in the unlocking position. At this position, if the door lock switch 45 is turned to contact the switching member 45a to the terminal 45b, as shown in Fig. 8. The driving circuit for the reversible
10 motor 7 is completed to drive the motor in the counterclockwise direction in relation to Fig. 2. The drive pinion 37 is thus rotate counterclockwise to drive the idler gear 40 clockwise. The idler pinion 39 is rotated clockwise together with the idler gear 40 via the
15 spring 41 to drive the rack member 8 counterclockwise. By the counterclockwise rotation of the rack member 8, the driving shaft 35 to which the rack member is fixedly secured, is rotate together the rotatable arm 36 into the position shown in Fig. 10. By the rotation of the
20 rotatable arm 36, the actuation arm 2 of the door lock mechanism 1 is pulled downwardly to place the door lock mechanism at the locking position.

At this time, the movable contactor holder 22 connected to the rack member 8 with the pin and cut-out
25 engagement is moved along the recess 26 of the terminal block. Assuming the contactor holder 22 is positioned at a position of Fig. 6 to connect the stationary terminals 32a

and 32b while the door lock mechanism 1 is maintained at the unlocking position of Fig. 2, the movable contactor holder 22 moves to right to establish electrical communication between the stationary terminals 32b and 32c with the contactor 33 as shown in Fig. 9. During this movement, the contactor 33 is placed in a position as shown in Fig. 8. In the position of Fig. 8, the contactor 33 connects the stationary terminal 32a to the stationary terminal 32c to keep power supply to the motor. At the contactor position of Fig. 8, the diode 34a blocks electric current flow therethrough to stop driving of the motor 7.

As long as the contactor 33 is kept at the position of Fig. 9, the door lock switch 45 is disabled to operate the actuator, further.

Here, according to the rotational movement of the rack member 8, the movable contact holder 22 is moved by an amount L_2 of Fig. 5 to move the contact 33 from the position of Fig. 7 to the position of Fig. 9. At the contactor position of Fig. 9, the contactor holder 22 is placed at a position to leave a clearance L_4 between it and the adjacent periphery of the terminal block 23.

In this door unlocking position, the projection 43 of the idler gear 40 abuts against the end 52 of the spring and, in turn the projection 42 of the idler pinion 39 abuts against the end 52 of the spring, as shown in Fig. 11. In this position, the spring 41 accumulates the spring force to rotate the idler gear 40

counterclockwise, when the motor 7 cease driving, as shown in Fig. 12. At the position of Fig. 12, the rack member 8, the rotatable arm 36 and the door lock mechanism 1 is maintained at the door unlocking position. When the door lock knob 3 is manually pushed down, the rack member 8 is rotated clockwise independently of the idler gear 40 to permit the door lock mechanism 1 to move to door locking mechanism, as shown in Fig. 13. Here, since the idler pinion 39 and the spring 41 can rotate independently of the idler gear 40, the operational force for pushing down the door lock knob 3 is satisfactorily reduced. This interengagement mechanism position corresponds to the actuator position as illustrated in Fig. 10.

In a switch position as illustrated with the phantom line in Fig. 1, the door lock mechanism 1 is in the locked position. At this position, even if the door lock switch 45 is turned to contact the switching member 45a to the terminal 45b, as shown in Fig. 9, since the movable contactor 33 is positioned at the position as shown in Fig. 9, the driving circuit for the reversible motor 7 does not supply power to the motor to drive same in the locking or clockwise direction of Fig. 2. At this position, the power is supplied to the reversible motor 7 in response to turning on of the door unlocking switch 46 to connect the switch member 46a to the terminal 46b. The drive pinion 37 is thus rotate counterclockwise to drive the idler gear 40 clockwise. The idler pinion 39 is rotated clockwise

... together with the idler gear 40 via the spring 41 to drive the rack member 8 counterclockwise. By the counterclockwise rotation of the rack member 8, the driving shaft 35 to which the rack member is fixedly secured, is rotated together the rotatable arm 36. By the rotation of the rotatable arm 36, the actuation arm 2 of the door lock mechanism 1 is pushed upwardly to place the door lock mechanism at the unlocking position, as shown in Fig. 2. At this position, the contactor 33 is placed at the position of Fig. 7.

In assembling the actuator 20, the terminal block 23 is positioned to place the stationary terminals 32a, 32b and 32c at an appropriate location with respect to the contactor 33 according to the door lock mechanism position. Here, since the terminal block 23 is so related to the switch casing 28 as to have a clearance L_3 between the opposing periphery of the terminal block and the recess 29, the adjustment of the relationship in position of the contactor 33 and the stationary terminals 32a, 32b and 32c can be done by moving the terminal block. At this time, the teeth 31a and 31b of the terminal block 23 and the switch casing 28 serves to fix the terminal block at the adjusted position.

While the present invention has been illustrated hereabove with respect to the specific embodiment, the invention should not be understood to be limited in the specific embodiment as set forth but includes all of the

. . possibly modification without departing from the principle
of the invention.

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WHAT IS CLAIMED IS:

1. A door lock/unlock system for an automotive vehicle comprising:

5 a mechanically operable door lock mechanism operable between a door lock position and a door unlock position;

an electrically operable actuator including:

10 electrical driving means mechanically connected to said door lock mechanism for operating said door lock mechanism between said door lock and unlock positions; and

a first switch coupled to said driving means and having a first and a second position settable respectively corresponding to the door lock and unlock positions of the door lock mechanism; and

15 a driving circuit connecting said driving means to an electric power source, said circuit having a second switch switchable between a first position in which said driving means is driven for operating said door lock mechanism in a door locking direction to move said door
20 lock mechanism to said door lock position and a second position in which said driving means is driven for operating said door locking mechanism in a door unlocking direction to move said door lock mechanism to said door unlock position, said circuit also including said first
25 switch to disable the driving means for operating said door lock mechanism in said door locking direction while said first switch is in first position and to disable the

. driving means for operating said door lock mechanism in said door unlocking direction while said first switch is in said second position.

5 2. A door lock/unlock system for an automotive vehicle comprising:

 a door lock mechanism coupled to a manually operable door lock knob for operation between a door lock position and a door unlock position;

10 an electrically operable actuator mechanically coupled to said door lock mechanism to operate the latter between said lock and unlock positions, said actuator including an electrically operable driving means operable in alternative directions for operating said door lock
15 mechanism in a door locking direction to move said door lock mechanism to said door lock position and in a door unlocking direction to move said door lock mechanism to said door unlock position;

 a first switch incorporated within said actuator
20 and operable between a first and a second position respectively corresponding to the door lock and unlock positions of the door lock mechanism; and

 a driving circuit connecting said driving means in said actuator to an electric power source, said circuit
25 having a second switch switchable between a first position in which said driving means is driven for operating said door lock mechanism in said locking direction and a second

position in which said driving means is driven for operating said door lock mechanism in said door unlocking direction, said circuit also including said first switch to disable the driving means for operating said door lock mechanism in said door locking direction while said first switch is in said first position and to disable the driving means for operating said door lock mechanism in said door unlocking direction while said first switch is in said second position.

10

3. The system as set forth in claim 1 or 2, wherein said actuator includes a portion movable by said driving means between first and second positions, and means coupling said movable portion with said door lock mechanism, said first and second positions of said movable portion corresponding respectively to said door lock and unlock positions of said door lock mechanism.

15

4. The system as set forth in claim 3, wherein said movable portion is coupled with said first switch to move said first switch between said first and second positions thereof, and said first switch includes means for holding said first switch in said first and second position thereof.

20

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5. The system as set forth in claim 3, wherein said driving means includes decoupling means for permitting said

. . door lock mechanism to be manually locked and unlocked without operation of said driving means.

6. A door lock/unlock system for an automotive
5 vehicle having a mechanically operable door lock mechanism adapted for operation between a door lock and a door unlock position and an electrically operable actuator operating the door lock mechanism between the door lock and unlock positions, said actuator having a reversible motor operable
10 in a first and a second direction respectively corresponding to the lock and unlock positions of the door lock mechanism, said system comprising:

 a first switch movable between a first and a second position in accordance with operation of the
15 actuator in one of said door lock and unlock directions, said first switch including means for holding the first switch in one of said first and second positions which corresponds to the position of the door lock mechanism; and

 a circuit including a second switch, said
20 reversible motor and said first switch, said second switch manually operable to supply electric power in said circuit in alternative directions for the reversible motor to operate said reversible motor in said first and second directions thereby operating said actuator in said door
25 lock and unlock directions respectively, said circuit preventing connection of said power supply to said motor when the second switch is operated to actuate said

· reversible motor in said first direction while the door
lock mechanism is in said lock position and to prevent
connection of said power supply to said reversible motor
when the second switch is operated in said second direction
5 while the door lock mechanism is in unlocking position.

7. The system as set forth in claim 6, wherein said
actuator further comprises a reduction gear and a rack
member which is associated with the door lock mechanism,
10 said reduction gear being interpositioned between said
reversible motor and said rack member so that it drives the
rack member in first and second directions corresponding to
said door lock and unlock directions of said reversible
motor.

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8. The system as set forth in claim 7, wherein said
reduction gear comprises a pair of idler gears interc-
onnected via a spring biased coupling means for permitting
the rack member to move independently of the motor rotation
20 while said door lock mechanism is manually operated.

9. The system as set forth in claim 7, wherein said
first switch is connected with said rack member so that it
is moved according to the movement of the rack member.

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FIG.1

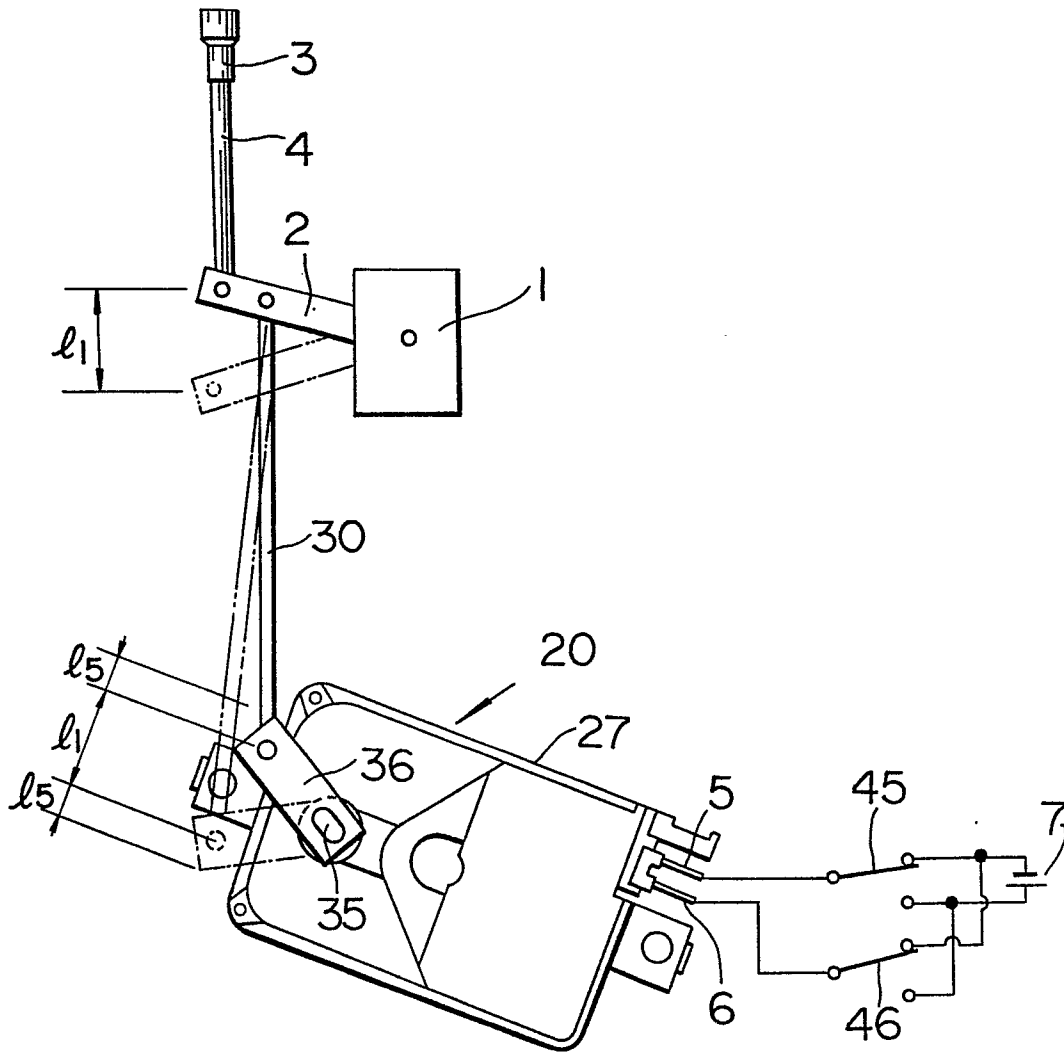


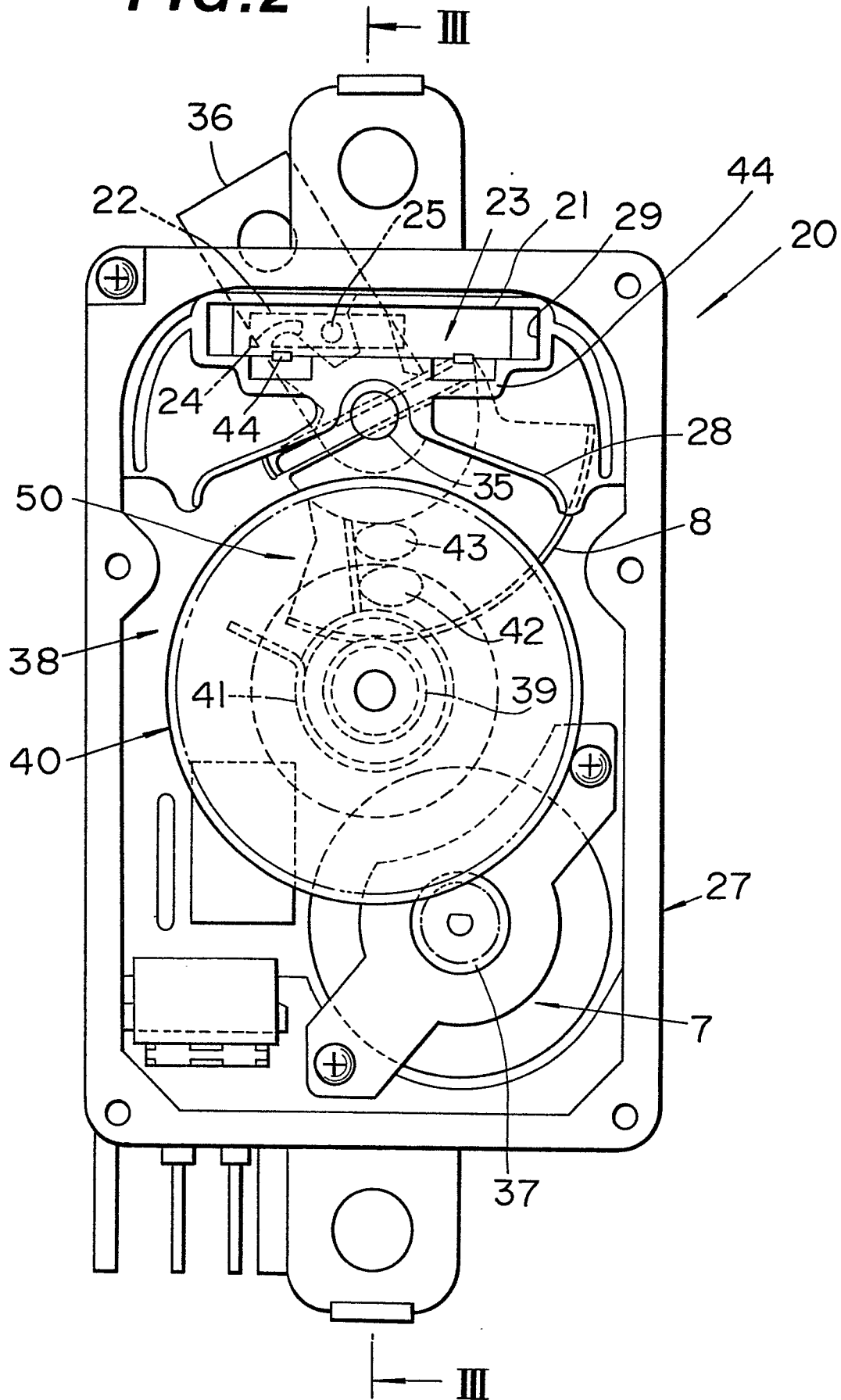
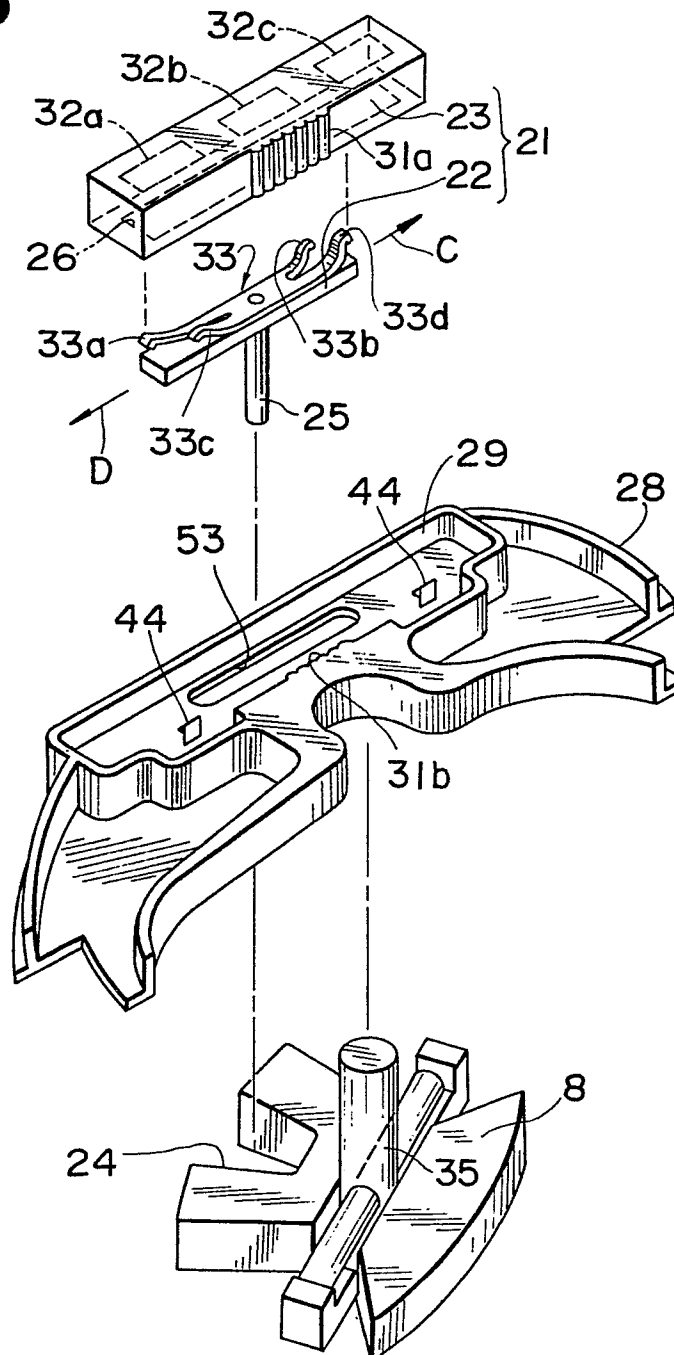
FIG. 2

FIG. 6

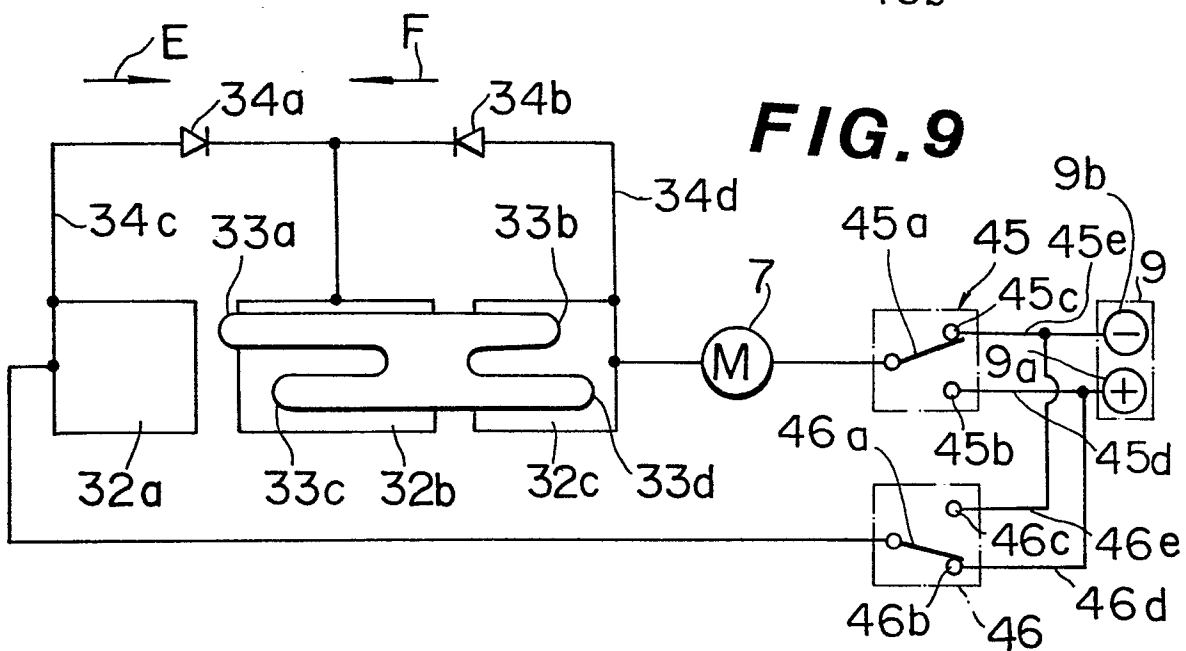
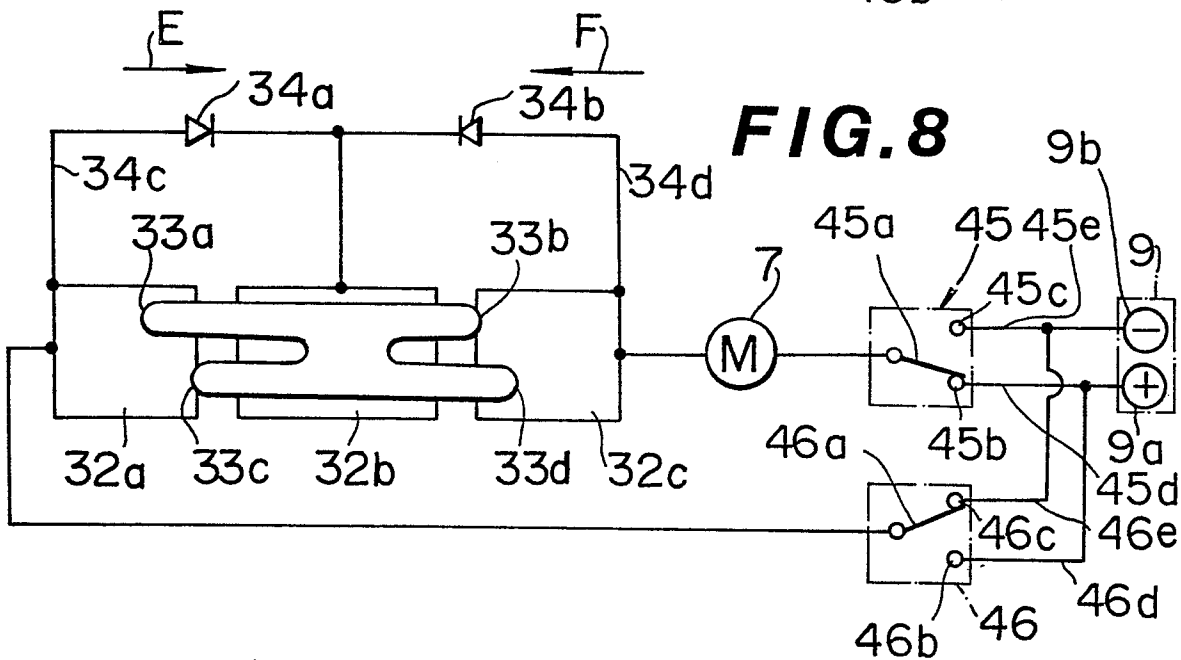
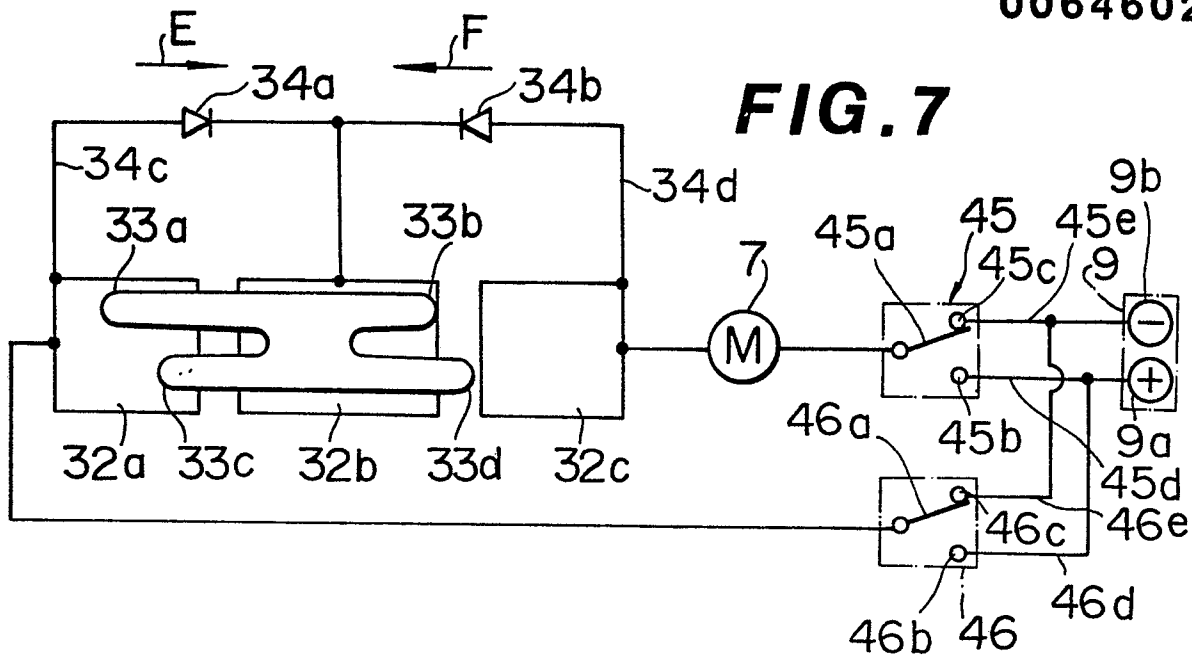


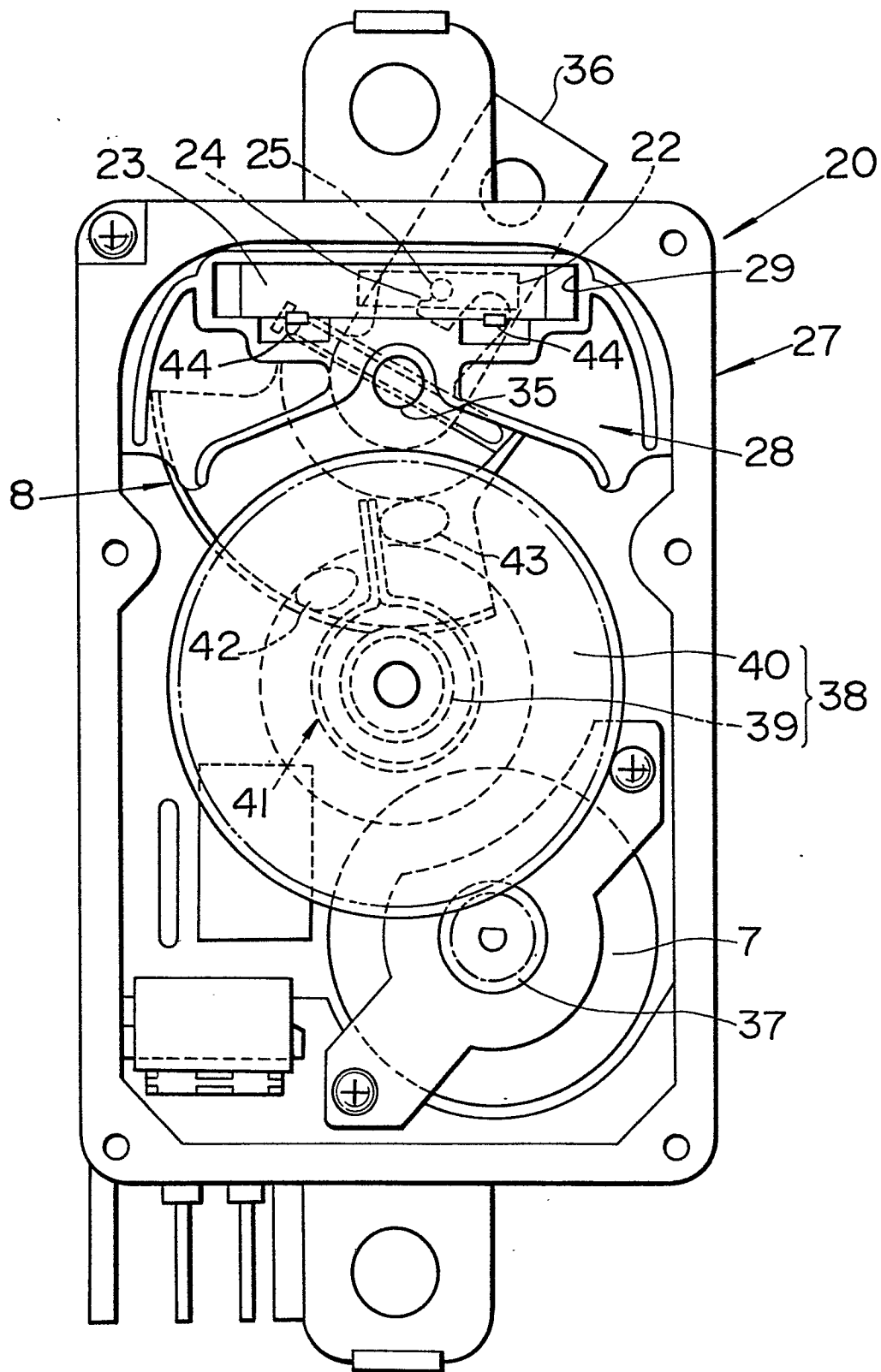
FIG.10

FIG. 11

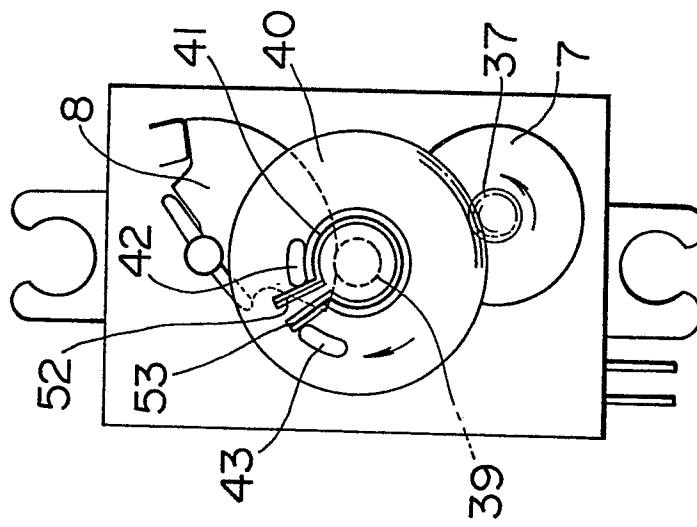


FIG. 12

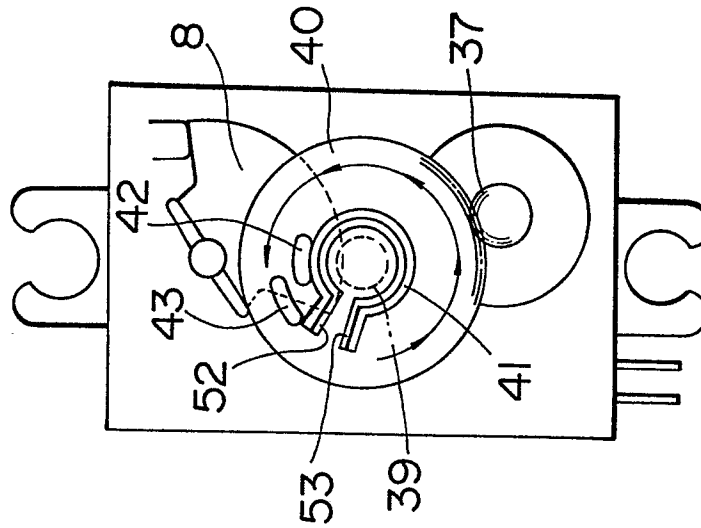


FIG. 13

